

REMARKS

Claims 1-42 are pending in this application.

At page 2 of the office action, Claims 1-42 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Rao (US Patent No. 5,889,903) in view of Presting et al. (US Patent No. 6,043,517). The Examiner admits to certain deficiencies in Rao. (Office action, page 3.) However, the Examiner resorts to Presting, citing column 1, lines 36-64 and column 3, lines 4-32 of Presting for a theory of incorporating material from Presting into Rao.

Applicant respectfully traverses the obviousness rejection.

Clock skew is the difference in arrival times of clock edges to different parts of a chip. Most conventional digital logic requires precise clocking, and ideal synchronous logic relies on clock signals arriving simultaneously to all.¹ There have been various attempts to solve a clock skew problem in computer systems and integrated circuits. Rao describes a method and apparatus for distributing an optical clock in an integrated circuit that eliminates clock skew by transmitting an infrared clocking pulse directed at the back surface of a Control Collapse Chip Connection (C4), flip chip, packaged chip. Silicon is partially transparent to infrared, so the optical clocking pulse penetrates through the silicon and is focused into P-N junction diode receivers at the front surface of the integrated circuit. The P-N junction diodes provide the electrical signals for local clocking. In Rao, the transparency of silicon is used and the optical clocking pulse is split and focused into a number of similarly configured P-N junctions distributed throughout the chip to provide local clocking so that clock skew is extremely small.² As Rao points out, only 1-2% of the photons are transmitted through a substrate that is approximately 720 μm thick. Rao addresses this problem by locally thinning the bulk silicon extending over the P-N junction receivers.³ Another problem with directing light

¹Applicant's specification, Background, page 1, lines 11-15.

²*Id.*, page 2, lines 14-22

³*Id.*, page 2, lines 25-29.

through the substrate, as described by Rao, is that the electrical conversion of the clocking signal may be blurred if the light passes through a substantial thickness of substrate. Light absorbed in the substrate generates minority carriers that have long lifetimes. The minority carriers in the Rao system persist for orders of magnitude longer
 5 than the clocking signal. The P-N junctions in Rao gradually collect these minority carriers, providing a background noise signal that decreases the signal to noise ratio of the clocking signal. This is particularly a problem if only 1-2% of the optical signal penetrates through the substrate to thin heavily doped regions.⁴

A person of ordinary skill in the art at the time of Applicant's invention
 10 recognized that Rao was uniquely suited to C4 packaging where the back side of the integrated circuit is exposed. Rao uses front side C4s for connections and avoids shadowing clock signal reception by directing the clocking signal reception by directing the clocking signal to the back side of the integrated circuit and through the chip to receivers on the front side. A person of ordinary skill in the art appreciated that Rao had
 15 accomplished much for improving clock skewing in C4 packaging, and that Rao's structure balanced complicated competing concerns. Such a person would think that modifying Rao's structure or materials would be an extremely tricky matter.

The presently claimed invention provides unexpectedly superior results over Rao, by more effectively providing synchronized optical clocking signals to a plurality of
 20 circuit components on a silicon substrate with minimal signal degradation and a better signal to noise ratio while continuing to avoid shadowing from metal interconnect layers on the front surface of the chip so as to minimize or eliminate clock skew.

Applicant's present invention clearly is much beyond what a person of ordinary skill in the art could have accomplished. The differences between Rao and the presently
 25 claimed invention are more significant than the Examiner has given credit. The elegance and apparent simplicity now that the Examiner knows Applicant's invention should not be confused with what a person of ordinary skill in Applicant's art at the time of the invention could have known and accomplished.

⁴A *Id.*, page 3, lines 1-9.

A person of ordinary skill in the art would not have been motivated to modify Rao as the Examiner has proposed. Rao is using only semiconductor 513. Rao has nothing special to say about the semiconductor 513. Rao fails to disclose any significance to be paid to the absorption coefficient of semiconductor 513.

5 Presting would not give the person of ordinary skill in Applicant's art motivation to modify Rao. Rao was particularly suitable to C4 packaging technology and particularly concerned with optical clocks. To the contrary, Presting was otherwise. Presting does not even mention clock skew. A person of ordinary skill in the art already has much technology specifically relating to clock skew. (As evidence, consider that
10 there are over 2,100 U.S. patents that mention "clock skew.")

A person of ordinary skill in Applicant's art would not take from Presting what the Examiner argues. He would not combine Rao and Presting. It would be too complicated for such a person of ordinary skill to try to balance Rao's considerations particular to clock skew in C4 packaging, with Presting that had nothing to do with clock skew. There
15 is nothing about Presting which naturally would make a person of ordinary skill, reading Presting in a normal, objective way, want to modify Rao.

When that person of ordinary skill in the art reads Presting, he is reading Presting without the special guidance that the Examiner now has (but must ignore) by virtue of Applicant's claims. Presting is directed to an SiGe photodetector with high efficiency
20 which can be operated in two wavelengths. Presting is concerned with photovoltaic detectors and solar cells. The problem that Presting was solving was that photodetectors operating in the two-wavelength mode in which III/V compound semiconductor materials are used have relatively low efficiency. Presting's objective was to provide a photodetector with high efficiency which can be operated at least in two wavelength
25 ranges. Presting is not relevant to Rao. The person of ordinary skill in the art would naturally treat what Presting is doing and what Rao is doing as separate, because there would be no sensible way to mix the principles from the two references in the mind of a reader of ordinary skill in Applicant's art.

Additionally, a person of ordinary skill in the art cannot reasonably be assumed to
30 want to make Rao's structure more complicated (whether by adding another material or

another layer or otherwise introducing more parts) unless a sound articulated reason exists. Usually, simplification, not additional complexity, is wanted.

For all those reasons, the Examiner's theory of combinability of Rao and Presting is an improper assumption.

5 Moreover, even with Rao and Presting, a person of ordinary skill in Applicant's art would not arrive at Applicant's presently claimed invention. Rao and Presting's respective structures are too different from each other.

Reconsideration and withdrawal of the obviousness rejection are respectfully requested.

10 In view of the foregoing, it is respectfully requested that the application be reconsidered, that claims 1-42 be allowed, and that the application be passed to issue.

 Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or
15 personal interview.

 A provisional petition is hereby made for any extension of time necessary for the continued pendency during the life of this application. Please charge any fees for such provisional petition and any deficiencies in fees and credit any overpayment of fees for the petition or for entry of this amendment to Attorney's Deposit Account No. 09-0458
20 (IBM Fishkill).

Respectfully submitted,


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